

## **Description of Additional Supplementary Files**

File Name: Supplementary Data 1

Description: List of core, near-core, and signature genes.

File Name: Supplementary Data 2

Description: Amino-acid identity (AAI) between virophage MCPs.

File Name: Supplementary Data 3

Description: Characteristics of freshwater NCLDV genome bins from Lake Mendota and Trout Bog Lake.

File Name: Supplementary Data 4

Description: Virophage hosts (NCLDV or 18S contigs) predicted from co-occurrence analysis.

File Name: Supplementary Data 5

Description: Eukaryote plankton diversity for Lake Mendota and Trout Bog Lake.

File Name: Supplementary Data 6

Description: List of metagenomic datasets from Lake Mendota and Trout Bog Lake.